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Original Research Article

Studies on Chemical Changes during Growth and Development of Aonla (*Emblica officinalis* Gaertn.) Fruit cv. Narendra Aonla-10

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A B S T R A C T

Gradual increase was observed in total soluble solids and ascorbic acid with the advancement of maturity in aonla under northern Indian conditions. Keeping in view above facts the present investigation entitled "Studies on chemical changes during growth and development of Aonla (*Emblica officinalis* Gaertn.) fruit cv. Narendra Aonla-10" is carried out with objectives to observe the chemical changes during growth & development of fruits and the maturity index for right stage of fruit harvesting during 2019-2020 at Main Experimental Station of Department of Horticulture, A.N.D. University of Agriculture and Technology, Kumarganj - Ayodhya (U.P.). Results showed that all chemical parameter of growth and development viz- Vitamin C and total sugar increased up to maturity.

Keywords

Chemical, Fruit, Parameter, Acidity and TSS

Introduction

Aonla (*Emblica officinalis* Gaertn.) is one of the most important traditional and under utilized fruits of Indian origin, having immense potential for cultivation on marginal or wastelands. It belongs to family Euphorbiaceae and indigenous to tropical Asia. Among all the fruit crops, aonla is the richest source of ascorbic acid, except Barbados cherry. It is grown all over Asia for its nutritional, medicinal and commercial value. Wild aonla trees are also found in China, Sri Lanka, Pakistan, USA (Hawaii and Florida) and Puerto Rico. In recent years, the processing and value addition of aonla has increased many folds due to increase in its area and production. Aonla has acquired wide popularity all over the world f or its medicinal properties. Its fruits are used in traditional Indian system of medicines, like ayurvedic, due to its therapeutic values (Agarwal and Chopra, 2004).

The growing popularity for alternate medicines, health foods, and herbal products are enhancing the demand for aonla fruit. Its fruits are rich in vitamin C, protein, fat, crude fibre, starch, sugars, minerals and tannins. Because of its highly acidic and astringent nature, the consumers do not relish this fruit in fresh form (Goyal *et al.*, 2008).

Aonla fruits are processed into a number of products like preserve, candy, pickle, juice, shreds, Ready-To-Serve (RTS) beverages, dried powder, etc. (Tandon *et al.*, 2003). The increase in yield and fruit quality is directly related to its time of maturation. Being an underutilized fruit crop, little attention has been given to establishing reliable maturity indices of aonla.

Parameters like days from flowering to maturity, heat units, color of fruit surface and TSS: acid ratio can be used for determining the maturity index of aonla cultivar in a particular region (Singh and Kumar, 1997: Singh *et al.*, 2004). Slow increment in fruit, stone and pulp weight, pulp: stone ratio, total soluble solids and ascorbic acid with the advancement of maturity in aonla has been reported by Gupta *et al.*, (2003).

Therefore, to find out the optimum time of harvest in aonla under rainfed conditions of Jammu subtropics, this study was conducted on three aonla cultivars; as so far, no such work has been done on aonla in this region. Therefore, the detailed knowledge gained regarding change in different parameters during growth and developments of aonla will be useful to determine the appropriate harvest stages and optimize its production.

Materials and Methods

The present investigation entitled "Studies on changes during growth and development of Aonla (*Emblica officinalis* Gaertn.) fruit cv. Narendra Aonla-10" was carried out at the main experimental station of Department of Horticulture, A.N.D. University of Agriculture and Technology, Kumarganj-Ayodhya (U.P.) during the year 2019-20. The details about the materials used and experimental procedure followed in the present studies are described here under following heads and subheads.

Source of materials

Aonla fruits for analyzing physical and chemical character were taken at the 30 days intervals from pea stage to maturity from selected aonla tree planted at the Main Experimental Station of Department of Horticulture. The fruits free from any visible sign of microbiological infection, insect infestation and physical injury were selected.

Technical programme

The technical programme comprises following three experiments: -

Experiments no. 1:- Observation on chemical changes of fruits during growth and development.

Replications :- 3

Interval :-30 days

Design: CRD

Observations recorded

Moisture (%), T.S.S. (%), acidity (%), vitamin C (mg/100g), reducing sugar (%), non-reducing sugar (%) and total sugar (%).

Methodology adopted in observations

Chemical character

Chemical analysis of fruit was done for the following parameters.

Moisture (%)

For estimation of moisture percentage, firstly weight of fresh fruits were taken and then these fruits for drying were kept in hot oven at 65^0C temperature. Fruits were dried till attaining constant dry weight.

Thereafter, weight of dry fruits was taken and then moisture percentage were calculated by following formula:-

$$\text{Moisture}(\%) = \frac{\text{weight of fresh} - \text{weight of dried fruit (g)}\ldots\ldots\ldots\ldots\ldots\text{fruit(g)}}{\text{weight of fresh fruit (g)}} \times 100$$

T.S.S. (%)

The total Soluble Solids (TSS) of the samples were determined with the help of hand refractometer in terms of percentage. The values of Total Soluble Solids recorded at ambient temperature were corrected at 20 ℃ with the help of reference table (Ranganna, 2000) and the mean value was expressed as per cent TSS content of the sample.

Acidity (%)

Titratable acidity was estimated by method suggested by Ranganna (2000). Fruit pulp 5g was taken and crushed in mortal and pistal and juice was separated through filtration with the help of muslin cloth. Aliquot of the juice sample were prepared by mixing distilled water for 100ml volume.

Titratable acidity was estimated by titrating 5ml fruit extract aliquot with 0.1 N NaOH using 1 % phenolphthalein solutions as indicator.

The titer values were recorded when the solution turns pink in color. The per cent titratable acidity was calculated and expressed as percent citric acid equivalent using the following formula.

$$\%\ \text{titratable acidity} = \frac{\text{Titre X Normality of the alkali X Volume made up X Equivalent weight of acid X 100}}{\text{Volume of Sample Taken for Estimation X Volume of sample Taken X 1000}}$$

Vitamin C (mg/100g)

To estimate vitamin C, extract of 5 ml fruit pulp of sample was taken into 50 ml volumetric flask and volume made up to 50 ml with 3% HPO_3 (Metaphosphoric acid) solution. Thereafter 5 ml aliquot were titrated against 2, 6-Dichlorophenol indophenol dye solution.

The end point was marked by appearance of pink colour, which persisted for at least 15 seconds (Ranganna, 2000). The content of Vitamin C was expressed in mg/100g sample after calculation using following formula:

$$\text{Ascorbic Acid (mg/100ml)} = \frac{\text{Titre value x Dye factor x Volume made up x 100}}{\text{Aliquot taken x Volume of sample taken}}$$

Standardization of dye

To 5 ml of standard ascorbic acid solution, 5 ml of 3% HPO_3 was added and Titrated with the dye solution to a pink color which persisted for 15 seconds or more to determine the dye factor, i.e. mg of ascorbic acid per ml of dye, using the following formula.

$$\text{Dye Factor} = \frac{0.5}{\text{Titre}}$$

Reducing sugar (%)

To determine the reducing sugars, extract of 5 ml fruit pulp was taken in 100 ml volumetric flask and volume was maintained 100 ml by distilled water. 5 ml aliquot was taken into conical flask and then 5 ml of each Fehling's solution 'A' and 'B' (Lane and Eynone, 1923) were added and titrated against 1.0 % glucose (Dextrose) solution in boiling condition using methylene blue as indicator.

Table.1 Changes in chemical attributes during growth and development of aonla fruit cv. NA-10.

Date of Sampling	Mosture (%)	TSS (%)	Acidity (%)	Vitamin C (mg/100gram)	Reducing Sugar (%)	Non-Reducing Sugar (%)	Total Sugars (%)
6/8/2019	82.24	2.35	0.97	20.67	1.04	0.60	1.63
6/9/2019	83.13	4.18	2.24	166.00	1.53	1.40	2.93
6/10/2019	83.71	7.73	2.92	275.60	2.14	2.66	4.80
6/11/2019	83.62	8.03	2.25	484.00	4.33	3.23	7.56
6/12/2019	81.85	8.79	1.91	728.70	6.76	2.95	9.71
6/01/2019	81.50	8.85	1.48	730.60	6.80	3.00	9.80
SEm±	0.70	0.36	0.12	2.22	0.13	0.14	0.23
CD at 5%	1.56	0.80	0.27	4.94	0.28	0.31	0.51

The appearance of light brick colour was marked as the end point. A blank sample was also titrated against 1% glucose (Dextrose).

The calculation was done with the help of following formula and results were expressed as per cent of reducing sugars

$$\text{Reducing sugars (\%)} = \frac{\text{(Blank titre value} - \text{Sample titre value)} \times \text{Volume madeup}}{\text{Aliquot taken} \times \text{Weight of sample taken}} \times 100$$

Total invert sugar

The 5 ml aliquot was taken out from 100 ml sample prepared for reducing sugars analysis, mixed with 3 drops of HCl and kept overnight. Next day 2-3 drops of phenolphthalein indicator were added and neutralized with 30 % sodium hydroxide solution.

Then 5 ml of each Fehling's solution 'A' and 'B' were added to neutralize aliquot and mixture was titrated against 1 % glucose (Dextrose) in boiling stage using methylene blue as indicator till appearance of light brick colour indicating end point. The results were expressed as per cent of total invert sugar:

$$\text{Total invert sugar (\%)} = \frac{\text{(Blank titre value} - \text{Sample titre value)} \times \text{Volume madeup}}{\text{Aliquot taken} \times \text{Weight of sample taken}} \times 100$$

Non-reducing sugar (%)

Non-reducing sugar was calculated with the help of following formula

Non-reducing sugar (%) = [Total invert sugar (%) – Reducing sugars (%)] x 0.95

Total sugar (%)

The sum of reducing sugars and non-reducing sugar was expressed as per cent of total sugars:

Total sugars (%) = Reducing sugars (%) + Non-reducing sugar (%)

Statistical analysis

The analysis of variance (ANOVA) of the data was carried out by the techniques as by Raghuramula *et al.,* 1983.

$$\text{Sem}\pm = \sqrt{\frac{\text{MSE}}{r}}$$

CD at 5% = S.E. x t value

Experimental Results

Biochemical constitutes of fruits

Moisture

Data presented in Table -1 indicates that the moisture percentage of aonla fruit cv. NA-10 was found 82.24% on 6th August and thereafter it increased up till 6th October and found to be maximum 83.71%. It is clear from graph that after 6th October, moisture percentage decreased up till 6th January and found to be minimum 81.50%.

Total soluble solids

The data on observation presented in table-1 reveals that the total soluble solids content in the fruit increased continuously from 6th August to 6th January and it was recorded 2.35% on 6th August to 8.85% on 6th January. The data grouped in show rapid increased in TSS between 6th August and 6th December.

Acidity

Data on acidity content of fruit during growth are presented in Table -1. The acidity content of aonla fruit was recorded minimum 0.97% on 6th August and maximum 2.92% on 6th October. After 6th October, it decreased up till 6th January and at this stage, it was recorded 1.48 percent.

Vitamin C

Data recorded on vitamin C content during growth and development of fruit furnished in Table -1 indicate that vitamin C content in aonla fruit increased up to harvesting of the fruit. The increase in ascorbic acid content was varied from 20.67 mg/100g to 730.60 mg /100g of fruit from 6th August to 6th January.

Reducing sugars

The data of Table-1 reveal that the content of reducing sugars showed increasing trend from starting stage of observation to end of observation. The reducing sugar content increased from 1.04% on 6th August to 6.8% on 6th January and the changes were statistically found to be significant.

Non –reducing sugar

Data recorded on changes in non-reducing sugar content of fruit during growth and developments are presented in Table- 1. The non-reducing sugar content was observed maximum (3.23%) on 6th November and minimum 0.6% on 6th August. The changes were significant.

Total sugar

It reveals from Table-1 that the total sugar content of aonla fruit increased continuously from starting of observation to end of observation up till 6th January and the variation was from 1.63% to 9.8% which was statistically significant.

The results from present investigation entitled "Studies on chemical changes during growth and development of Aonla (*Emblica officinalis* Gaertn.) fruit cv. Narendra Aonla-10)" was carried out at Main Experimental Station of the College of Horticulture & Forestry, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Ayodhya 224229 (U.P.) India during the years 2019-2020.

The result of the present investigation can be summarized and concluded as follows:-

Moisture percentage increased from 6th August to 6th October then decreased till 6th January and at this stage it was found to be 81.50%.

Total soluble solid percentage recorded during 6th August to 6th January increased till 6th January. At this stage, it showed maturity in cultivar.

Acidity percentage increased during initial stage of growth and development then decreased till 6th January and at this stage it found to be 1.48%.

Vitamin C content observed during growth and development of fruit increased till maturity stage.

Reducing sugar percentage recorded during observation period showed increasing trend till 6th January and fond to be 6.8%.

Percentage of non-reducing sugar showed significant change during 6th August to 6th January.

Total sugar percentage observed during growth and development period increased till 6th January and found to be 9.8%.

T.S.S. to acid ratio showed significant change during 6th August to 6th January. It decreased till 6th November and then increased till 6th January.

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